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Introduction to the IEC 61 439-2 standards and the effects on the low voltage switchgear industry

Introduced in 1993 the IEC 60439 standard was intended to harmonise the low voltage industry with an objective to form one standard that offered protection for personnel and switchgear. It also tried to be a complete standard that covered the total performance of a low voltage assembly and that of individual products that are fitted within the assembly.

This one standard regulated the different types of switchgear and classified them as TTA (type-tested switchgear assemblies) or PTTA (partially type-tested switchgear assemblies).

What has changed under the new standard?

The new standard IEC 61 439 is the successor to the IEC 60439 and comes into force from November 2014. However the new standard has already been implemented by the IEC and customers are specifying low voltage switchgear to the new IEC 61439 standard.

The structure of the new standard has been broken down in to a general part and product specific parts as highlighted below.

New standard	Previous standard	Subject
IEC / EN 61 439-1	IEC / EN 60439-1	General rules
IEC / EN 61 439-2	IEC / EN 60439-1	Power switchgear and controlgear assemblies
IEC / EN 61 439-3	IEC / EN 60439-3	Low current distribution boards
IEC / EN 61 439-4	IEC / EN 60439-4	Assemblies for construction sites
IEC / EN 61 439-5	IEC / EN 60439-5	Assemblies for power distribution
IEC / EN 61 439-6	IEC / EN 60439-2	Busbar trunking systems
IEC / EN 61 439-7	No former standard	Assemblies for specific applications, rooms and installations
IEC / EN 61439-0	No former standard	Specifiers guide

It is worth noting that national appendix (NA) may distinguish from the original IEC 61 439-1 to 7 and overwrite. For example the British Standards allow for different terminology regarding the form rating of the power switchgear assembly. This would show as: BS EN / IEC 61 439-2.

Rittal's Ri4Power modular low voltage switchgear system has been tested to the new IEC 61 439-2 standard, which incorporates testing and developing new products that previously were not required under the IEC 60439-1. The outcome of the new testing procedures and results can be found in a dedicated design software package Rittal Power Engineering and the technical system manual for Ri4Power.

Key change 1

The terms for type-tested switchgear and controlgear assemblies (TTA) and partially type – tested switchgear and controlgear assemblies (PTTA) used in IEC 60439-1 have been removed.

For new power switchgear and controlgear assemblies the type test reports have been replaced by design verification. The previous routine test report has been replaced with routine verification.

There are 13 design characteristics and in total 21 single verifications specified by the IEC 61 439 that need to be verified by: testing; comparison with a reference design and assessment (some of the characteristics highlighted in the table below). All of the relevant verifications that enables Ri4Power modular switchgear to meet the IEC 61 439-2 standard have been carried out at the international well known IPH test labority and Rittal’s own accredited test labourites. A full range of verification tests can be found with Rittal Power Engineering Software.

Tests on individual devices to their respective product standards are not an alternative to the design verification in this standard for the assembly.

Individual verifications and verification methods

This table is not complete!
see Screenshots below

Available verification options

No	Characteristic to be verified	Section	Testing	Comparison with a reference design	Assessment
1	Strength of materials and parts: Resistance to corrosion Resistance to UV radiation	10.2….. 10.2.2 10.2.2	 • •		 •
2	Protection category of enclosures	10.3	•		•
3	Clearances	10.4	•		•
4	Creepage distances	10.4	•		
5	Protection against electric shock and integrity of protective circuits Short-circuit withstand strength of the protective circuit	10.5 10.5.3	 •	 •	
6	Incorporation of switching devices and components	10.6			•
7	Internal electrical circuits and connections	10.7			•
8	Terminal for external conductors	10.8			•
9	Dielectric properties: Power frequency withstand volte	10.9 10.9.2	 •		
10	Temperature-rise limits	10.10	•	•	•
11	Short-circuit withstand strength	10.11	•	•	
12	Electromagnetic compatibility (EMC)	10.12	•		•
13	Mechanical operation	10.13	•		

No.	Characteristic to be verified	Section	Available verification options		
			Testing	Comparison with a reference design	Assess-ment
1	Strength of materials and parts:	10.2			
	Resistance to corrosion	10.2.2	■	–	–
	Properties of insulating materials:	10.2.3			
	Thermal stability	10.2.3.1	■	–	–
	Resistance to abnormal heat and fire due to internal electric effects	10.2.3.2	■	–	■
	Resistance to ultra-violet (UV) radiation	10.2.4	■	–	■
	Lifting	10.2.5	■	–	–
	Mechanical impact	10.2.6	■	–	–
	Marking	10.2.7	■	–	–
2	Protection category of enclosures	10.3	■	–	■
3	Clearances	10.4	■	–	–
4	Creepage distances	10.4	■	–	–
5	Protection against electric shock and integrity of protective circuits:	10.5			
	Effective continuity of the connection between exposed conductive parts of the assembly and the protective circuit	10.5.2	■	–	–
	Short-circuit withstand strength of the protective circuit	10.5.3	■	■	–

No.	Characteristic to be verified	Section	Available verification options		
			Testing	Comparison with a reference design	Assess-ment
6	Incorporation of switching devices and components	10.6	–	–	■
7	Internal electrical circuits and connections	10.7	–	–	■
8	Terminals for external conductors	10.8	–	–	■
9	Dielectric properties:	10.9			
	Power-frequency withstand voltage	10.9.2	■	–	–
	Impulse withstand voltage	10.9.3	■	–	■
10	Temperature-rise limits	10.10	■	■	■
11	Short-circuit withstand strength	10.11	■	■	–
12	Electromagnetic compatibility (EMC)	10.12	■	–	■
13	Mechanical operation	10.13	■	–	–

Taken from IEC 61439-1, Table D1, Annex D

Verification of temperature rise (part 10.10 of the standard) is the most time-consuming verification and can be expensive, regardless of which method is used. For verification of temperature rise, the options available are:

- Testing
- Derivation of the rated values of similar variants
- Calculation methods

Verification using the calculation method is confined to low voltage controlgear assemblies up to 630A and 1600A. For higher current ratings derivation and testing verification must be performed. It is a requirement to record all heat rise data and the method of verification used. Heat rise calculation and the effect of heat on the assembly is critical to the performance of components, such as circuit breakers, fuses and controlgear.

For example moulded case circuit breakers are compliant to IEC 60947 which tests the circuit breaker in free air. The performance of the circuit breaker is then recorded.

Under IEC 61 439 the circuit breaker is tested within an assembly. The maximum rated performance of the circuit breaker can deviate from the nominal rating because the environment has changed for the circuit breaker. Higher ambient conditions will apply due to environmental conditions such as: the protection category (IP rating), size of functional unit (size of the enclosure where the circuit breaker is fitted) or assemblies with forced ventilation etc.

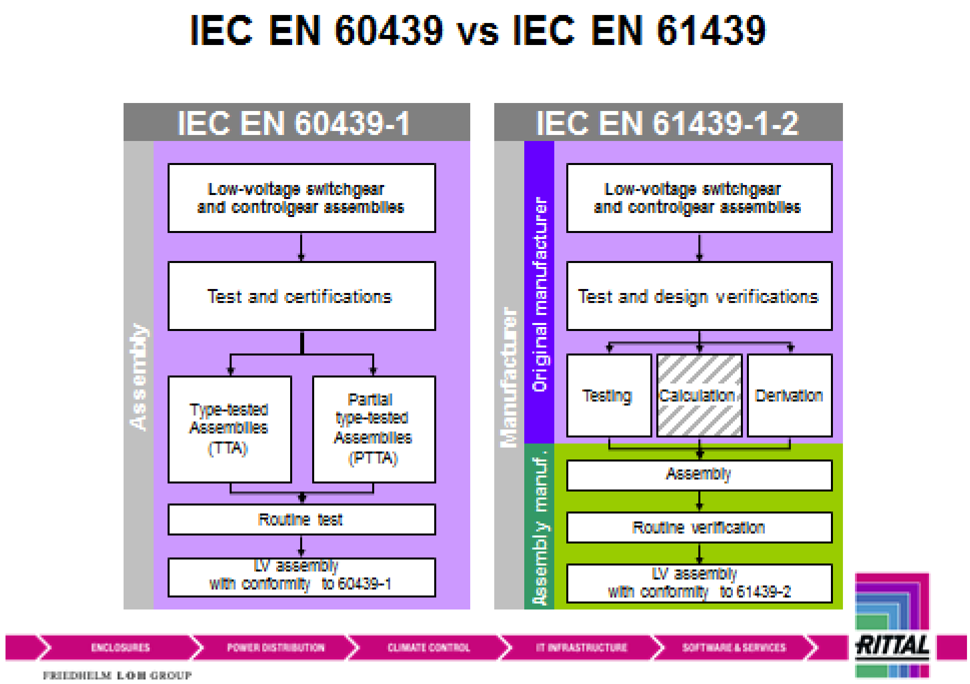
For verification of temperature rise, the actual achievable rated current and the rated diversity factor of the respective circuit should be indicated for both the manufacturer and the user. Merely stating the rated currents of the switchgear or individual components of the assembly is not sufficient, since this may not make allowance for environmental influences as previously stated.

Rittal has undertaken temperature rise testing with the leading manufacturers of circuit breakers in various functional unit sizes and recorded all test data. The results have been published within Rittal's Ri4Power systems' catalogue and shows the de-rated current rating of the circuit breaker. This figure should be used by the design engineer when specifying circuit breakers. Another feature of the new standard is the naming of Inc as the rated current of the circuit (operating current of the load and not the rating of the circuit breaker as listed under IEC 60947, free air testing).

Key change 2

The standard divides responsibility for the manufacture of a low voltage switchgear assembly between the original manufacturer and the assembly manufacturer. The original manufacturer is the organisation that originally developed the switchgear system and who is responsible for carrying out the design verification tests (Rittal). The assembly manufacturer is the organisation which builds the switchgear and controlgear assembly for a customer application (typically a panel builder or engineering company) and is responsible for carrying out routine verification tests. These routine verification tests confirms the assembly has been manufactured in-line with the original manufacturer's recommendations and design rules.

The diagram below shows the key differences between the IEC 60439 and IEC 61 439 standards. The responsibility of the original manufacturer and assembly manufacturer are clearly shown.



In Summary

Many of the verifications required for IEC 61 439 refer to a combination of different products and components in a switchgear and controlgear assembly. For example, evidence of protective circuit function requires testing of a defined protective circuit arrangement in a defined enclosure construction. A low voltage switchgear and controlgear assembly has to be a system consisting of: Enclosures, Cooling systems, Busbar systems and Devices.

The standard defines the split between the original manufacturer and assembly manufacturer and has clearly defines the responsibility of each organisation in regard to testing.

Any ambiguity between type tested and partially tested assemblies from IEC 60439 have been replaced with 13 design verification characteristics, which clearly describe the individual tests that must be carried out.

Heat rise and the performance of devices inside a functional unit (enclosure) within the low voltage switchgear and controlgear assembly is a major consideration for design engineers. Heat rise test data provides information on the performance of the device and may lead to de-rating.

The new standard IEC 61 439 is applicable to: LV power distribution switchgear; Motor Control Centres; control panels – lighting, PLC, industrial application etc; metering panels; wall mounted enclosures; sub distribution boards; busbar trunking systems and assemblies for construction sites.

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Further information: John Wilkins
Marketing Services Manager
Tel: 01709 704000
e-mail: information@rittal.co.uk